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BIOLOGICAL RESEARCH SECTION 1985 ANNUAL REPORT

Report No 86-129-K

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ABSTRACT

The activities of the Biological Research Section during 1985 are reviewed. Major efforts planned for 1986 are identified.

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TO: Mr. F.J. Kee
Director of Research

BIOLOGICAL RESEARCH SECTION
1985 ANNUAL REPORT

INTRODUCTION

The Biological Research Section is a research unit of the Ontario Hydro Research Division. The unit is headquartered in Building KD of the Kipling Complex located at 800 Kipling Ave, Toronto.

The functions of the Section are to provide a research service and to carry out scientific investigations in biological areas in support of Ontario Hydro's planning and operational activities.

The purpose of this document is to provide an overview of the major activities undertaken by the group in 1985, highlight some of the accomplishments, and describe the major thrusts anticipated for 1986.

The Section's Structure

Up to 1985 the Section was administratively organized to meet the requirements of the Corporation's supply strategy. It was anticipated in 1984 that reorganization of the Section will need to be considered. The driving forces behind reorganization were related to the desire to increase the flexibility required for the search of novel opportunities while insuring that the environmental needs of our stakeholders are met. The Section was reorganized in the spring of 1985. The new organizational structure is shown in Appendix A.

The net result of the reorganization was to flatten the reporting relationships, moving the unit more into a program management mode while maintaining a rigid structure only in areas where a demand for long term capability exists. The reorganization resulted in the Section consisting of a unit dedicated totally to supporting the Corporation's requirements for environmental surveys and monitoring programs (the Biological Surveys and Monitoring Unit). The Biological Surveys and Monitoring Unit has the function of carrying out the required pre- and post-operational biological surveys at generating stations, and when called upon, to carry out impact assessment research, and to

support other units in field studies. The remainder of the Section retains flexibility by dedicating resources to problems requiring technical solutions as needed, and coordinating these efforts by appointed individuals for the duration. The majority of the supporting staff is integrated and assigned to specific projects from a centralized pool administered by the supervising technician.

During 1985 the following staff left the Biological Research Section: Mary Kirby, Jill Battrick, Peter Atkins and Larry Onisto. Ms. Irene Masliwec joined the Section during the same period. A staff list is presented in Appendix B.

Short and Long Term Objectives

The long term objectives of the Section are to maintain an environmental capability with the emphasis on providing an extensive and reliable survey of environmental effects studies capability, and to carry out anticipatory studies in other areas of need so as to create opportunities which will lead to increased effectiveness and efficiency for the Corporation.

As identified in the 1984 review, the plans for 1985 were to redirect efforts into areas which may create opportunities for the Corporation, such as vegetation control, fish impingement, tritium removal by catalysis, application of biotechnological techniques, remote sensing, and development of thermal aquaculture.

Through 1985 major areas of effort were: Pre- and Post-operational Aquatic Surveys, Radionuclide Program, Vegetation Control Program, Contract Impingement Studies, Thermal Aquaculture, and Tritium Removal by Biological Catalysis.

A list of reports issued and their respective sources of funding are shown in Appendix C; a list of publications on Appendix D; papers presented at conferences in Appendix E, and external contracts in Appendix F.

1985 WORK PROGRAM AND ACCOMPLISHMENTS

Aquatic Surveys and Monitoring

Pre- and Post-Operational Surveys

These studies are carried out on behalf of Design and Development Division in partial compliance with the provincial environmental regulatory agencies as part of the licensing process for new generating stations.

The objective of these studies is to determine through an extensive monitoring program, the effects, if any, of the con-

struction and operation of new generating stations on the aquatic environment, and to verify conclusions of the environmental assessment documents. These programs normally consist of three phases; a pre-operational period during construction, a commissioning period and an operational period when the station has reached full capacity.

During 1985 studies were continuing at Pickering NGS 'B' (commissioning), Bruce NGS 'B' (commissioning), Atikokan GS (commissioning and post-operational), and Darlington NGS (pre-operational).

Commissioning studies at the two Great Lakes sites, Bruce NGS 'B' and Pickering NGS 'B', suggest that the initiation of pumping in the cooling circuit and discharge of warm water resulted in local changes in the distribution of certain fish species in the area of the thermal discharge.

At Atikokan GS, an inland station which uses quasi closed-looped cooling circuits made up of a series of small lakes, pumping at the station resulted in a lowering of the thermocline below the depth of the intake in Moose Lake (the water source). Walleye initiated spawning at the outflow of Snow Lake into Icy Lake (Snow Lake being a small lake which is the recipient of the thermal effluent from the station). The impact of the station operation on the fish community has yet to be determined.

In addition to the studies listed above, a survey of the terrestrial habitats and biota was carried out at Bruce NGS 'B', and an aquatic survey of the Mississagi River to determine the effects of shoreline stabilization near Iron Bridge, Ontario were conducted.

Additional short term studies were conducted at the sites as required.

In 1986 aquatic surveys will continue at Atikokan GS, Bruce NGS 'B', Pickering NGS 'B', and Darlington NGS. In addition, we anticipate to initiate studies at one of the remote hydraulic sites in Northern Ontario. To enhance the Section's ability to gather good underwater information, a remote-controlled submersible with good video capability will be acquired. This purchase will allow the remote acquisition of underwater information quickly, safely, and to a greater extent than had been possible before.

IMPINGEMENT PROGRAMS

Our Section has, since 1978, specialized in the development and testing of behavioural means of preventing fish from entering generating station intakes. Through the years we have developed a considerable expertise and capability and are currently

contributing to the solution of fish exclusion problems both in Canada and abroad. The uniqueness of our capability has come about through the gaining of specialized knowledge over the past eight years, coupled with the availability of exceptional large scale laboratory facilities in the Ontario Hydro Flow Systems Laboratory, and the Pickering Fish Diversion Structure in the field, and through the cooperation and support of several Research departments and other Ontario Hydro divisions.

In 1985 a number of studies were carried out primarily for the Electric Power Research Institute (EPRI), the Empire State Electric Research Corporation (ESEERCO), Ontario Hydro's Capitalized Once-Through-Cooling program (COTC), and a variety of site-specific studies.

EPRI has initiated a program to evaluate selected behavioural exclusion systems at sites representative of various types of water bodies. The Pickering Fish Diversion Structure was selected as the representative site for the Great Lakes. In the study the effectiveness of a pneumatic popper, air bubbles and strobe lights were evaluated as deterrents for excluding adult alewife. A single pneumatic popper was found to effectively exclude alewife from the structure whereas air bubbles when used alone were not consistently effective. The addition of either a popper or strobe lights to the air bubble wand considerably improved the performance of air bubbles as a deterrent. This study will continue in 1986.

Previous studies had yielded encouraging results in the use of pneumatic poppers for repelling a variety of fish species; however, the poppers' unreliability raised into question their degree of usefulness. Consequently two unique prototypes of sonic devices were developed with Mechanical Research as alternatives to a pneumatic popper; these are referred to as the "fishdrone" and "hammer."

The "fishdrone" device uses a sonic vibrator to excite a metallic structure at resonance which is then transmitted into the water column. This device is a good experimental tool since high acoustical sound pressure levels can be generated at fundamental frequencies ranging from approximately 20-1000 Hz. Experiments were conducted on the responses of introduced centrarchid species (eg, pumpkinseed) to various sound frequencies in the Lennox GS forebay. Avoidance responses varied with a fundamental frequency of approximately 150 Hz producing the most pronounced response. Similarly, selected frequencies of the fishdrone were noted to repel adult gizzard shad in the discharge of Lambton TGS. Additional experiments with this device involving shad are planned at Lambton in 1986.

The other sonic device, the "hammer" is a link-mass impact device which produces a repetitive impulse sound of high

amplitude sound pressures by exciting resonant vibration modes of a structure which is in direct coupling with the water column. This device is more similar to the popper than the fishdrone in terms of energy release and frequency. The "hammer" was evaluated at both Lennox TGS and the Pickering NGS Fish Diversion Structure. Results suggest that this device is similar in effectiveness as the popper in repelling adult alewife. Further evaluation of this device is planned at Pickering NGS in 1986.

The effectiveness of a Hidrostal pump in the live transfer of American eels was evaluated at Saunders GS. A total of 2300 eels was passed through the pump with no mortality. The pump has been recommended for transferring eels during dewatering practices at Saunders.

In addition to continued deterrent studies at Lambton and Pickering NGS, studies in 1986 are also proposed in the lab and in the field at one or more hydroelectric sites. External contracts for 1986 have been awarded by the Canadian Electrical Association for work involving behavioural systems at various hydroelectric sites outside Ontario, and by the Power Authority of New York on lab work involving the responses of striped bass and white perch to sound. A lab study has also been proposed to determine why some fish respond more to sound than others.

Studies carried out under the auspices of COTC include development of an "early warning" sonar system to detect large schools of fish in the vicinity of CCW intakes and activate diversion apparatus prior to entrapment continued in 1985 with the identification of appropriate equipment and initial field testing in the Nanticoke TGS forebay.

Tests of various fish attraction and leading systems in association with a Hidrostal pump to remove fish from the Pickering NGS 'B' forebay were carried out during 1985. The results of this study and an earlier study at Bruce NGS 'A' suggest some criteria which must be met for the successful installation of a forebay fish removal system.

OTHER AQUATIC STUDIES

A contract was awarded by the Nanticoke Environmental Committee to review 15 years of environmental data collection in Long Point Bay on Lake Erie. The objective of the study is to assess the impact of industrialization in the region. The study is expected to be completed in the third quarter of 1986.

A study to determine the abundance, species composition, and mortality of larval fish being entrained at the Bruce NGS 'A' site was carried out from April to September. Burbot, rainbow smelt, alewife and deepwater sculpin accounted for 88% of the eggs and 98% of the larvae collected in the intake-forebay

respectively. A substantial percentage of the smelt and alewife was classified as dead prior to collection. Larval mortality attributable to intake passage was greater for all species than passage through the station. Immediate survival following entrainment was greatest for alewife and smelt, followed by burbot and deepwater sculpin. Entrainment losses of smelt and burbot were equivalent to 12 and 6 per cent of the respective Canadian commercial catch for Lake Huron.

RADIONUCLIDE PROGRAM

The goal of the radionuclide program in the Biological Research Section is to support Ontario Hydro's Nuclear Generation Program by providing results which will enable the development of models describing the behaviour of key CANDU and Tritium Recovery Facility radionuclide emissions in the terrestrial and aquatic environments.

Molecular Tritium Studies

Determining the conversion of molecular tritium to either tritiated water (HTO) or organically-bound tritium (OBT) remains an important task because of the large differences in radiotoxicity between the various forms of tritium. The radiotoxicity of HTO is about 10 000 times greater than that of HT.

Recent laboratory and field studies have demonstrated that soils rather than vegetation or plant litter are the dominant sites for HT conversion in the terrestrial environment. The soil biological conversion process is attributed to microbes. Measurement of soil HT deposition velocities, necessary for deposition and transport modeling, ranged from 0.07 to 0.007 cm/s over bare soils and those with vegetation cover. Key parameters affecting soil microbial activity are water content, porosity and organic content.

Further laboratory studies were undertaken in 1985 to improve on the limited predictive ability of a descriptive model relating soil water content, organic content and porosity to HT deposition and conversion. Both the conversion rate (biological oxidation rate) and diffusion were measured in sectioned soil cores to allow development of a simpler mechanistic model for predicting deposition rates.

Further investigation of HT conversion in six vegetation species including two nitrogen fixers (soybean and alder), which have potential for molecular hydrogen uptake, has confirmed low deposition rates. All values were less than 0.005 cm/s. HT deposition rates to leaf litter of these species were similarly low except for white pine and alder which were 0.02 to 0.03 cm/s. The latter values fall within the range measured for loamy-sand

alone. This study demonstrates that certain litter types as well as soils are important sites for HT conversion.

Tritiated Water and Food Studies

Laboratory experiments on the dynamics of tritium uptake by small mammals were completed in 1985. Particular reference was placed on the potential for tritium accumulation in organically-bound tritium compartments of animals following prolonged exposure. Mice were exposed to tritiated drinking water, a diet containing tritiated amino acids or both for a period of eight weeks. Analyses of tissue-free water tritium (TFWT) and OBT from whole mice during the exposure period and for five weeks following exposure are in progress.

Cooperative Tritium Studies with CPPTP

The Section participated in the planning of an experimental field study of molecular tritium conversion in the environment. The purpose of this study is to determine reliable conversion rates of HT given the large variance between French and North American data. Concentration relationships between HT in air and soils and vegetation predicted by laboratory experiments will be validated by field HT concentration time histories.

Distribution and Abundance of Gamma Radionuclides in Sediments

Further sediment samples have been collected from the deep basins (Niagara and Mississauga) of west-central Lake Ontario to determine potential associations between elevated ^{60}Co of these basins and the Niaraga River area. Initial measurements show that only ^{137}Cs and not ^{60}Co was detectable in the Niagara River area and the two basins. No causal relationships are suggested between Niagara River sources and these profundal basins.

Batch techniques were employed in the laboratory to determine the partitioning between water and sediments of two common gamma-emitting radionuclides (^{60}Co and ^{137}Cs) released to the aquatic environment. Sediments were collected from the nearshore zone of Lake Ontario at Pickering NGS and from the deeper basins of the lake. Distribution coefficients, Kd's, varied by an order of magnitude among sediments from different sites but were not directly related to location or collection depth. Kd's of the two radionuclides were highly correlated ($r < 0.95$), with ^{137}Cs Kd's about ten times those of corresponding ^{60}Co Kd's. The observed Kd's were also correlated with sediment physical and chemical properties including ^{60}Co activity, cation exchange capacity, organic and particle size.

In 1986 a simple mechanistic model to predict HT deposition rates in soils will be developed and reported upon. Studies of deposition rates to litter, and the determination of the role of

litter in HT deposition will be determined. Much of the radionuclide work described above will be reported through 1986. After 1986 it is anticipated that the radionuclide studies will begin to wind down and 1987 will be primarily a year of synthesis of contributions.

Biological Catalysis for Tritium Removal

Several potential applications exist for ambient temperature catalysis of hydrogen conversion reactions within the areas of fusion and fission technology. Certain bacterial strains are capable of producing the enzyme hydrogenase, which catalyzes conversion reactions between the elemental and oxide forms of hydrogen, deuterium and tritium. In 1985 two of three bacterial strains which were evaluated were found to possess high hydrogenase levels when grown on a variety of organic substrates. It was also found that elemental tritium was rapidly oxidized to tritiated water by both bacterial strains. Further studies on the most promising strain were carried out to identify the optimum substrate and other growth parameters. In preliminary studies it was found that at normal atmospheric conditions exponentially growing cells were capable of effecting the maximum rate of tritium conversion.

Through 1986 it is anticipated that work will continue at a similar or partially enhanced level of effort, with the emphasis on parameterizing the conditions for tritium conversion as well as assessing potential rates.

Biosynthesis of Deuterated Organic Compounds

Deuterated synthetic lubricants have enhanced oxidative stability and hence a longer useful lifetime than their proteated counterparts. The prohibitive costs for chemically substituted deuterated lubricants have greatly restricted the use of these materials. If such products could be produced at a reasonable cost by biosynthesis the potential for a major non-nuclear market for heavy water may be created.

During 1985 a review of the literature of microbial biosynthesis and deuteration of organic starting materials that could be used in the production of synthetic lubricants was carried out. The results of the review indicated that photosynthetic green algae with lipid contents as high as 40% of cell dry weight are available for the production of fully deuterated fatty acids. These algae are worthy of consideration because in addition to the high lipid contents they can also be grown in concentrated heavy water medium in closed systems, and require only inorganic precursors for growth. Estimated lipid production rates in heavy water medium could approach 0.4 g lipid/L/day while volume of medium used in algal culture could exceed 100 L. Potential strategies for production were considered.

In 1986 it is anticipated that laboratory research will be initiated to develop the biosynthesis process and to test some of the conclusions of the 1985 review. If the work is undertaken it is anticipated that a minimum of two years of bench scale studies will be required to fine-tune the culture system prior to the development of commercial technology.

VEGETATION CONTROL PROGRAM

The primary goal of the vegetation control program is to obtain, through research, information which may create opportunities for more effective, efficient, and environmentally responsible means of controlling undesirable vegetation on both transmission and distribution rights-of-ways. The capability to meet the goal is maintained by carrying out studies directed towards exploring novel concepts of vegetation control, attempting to improve on existing control techniques, providing environmental information, evaluating new products, and expanding the knowledge base of the cause of vegetation problems.

Through 1985 studies to identify and evaluate allelopathic species and substances, studies to determine the effectiveness of soil applications of Tordon 101 and Triclopyr, studies evaluating the trunk injection techniques of growth regulators, environmental studies to determine the movement of Tordon 101 off of rights-of-ways, and studies of succession on new rights-of-ways were carried out. In addition, the growth of influence of time of treatment on sprouting was being monitored as part of a long term study.

In the allelopathic areas investigation of the concept of controlling vegetation by identifying cover crops and the chemicals involved in the inhibition of germination of woody species continued. The concept was explored by determining the ability of aqueous extracts of grasses and legumes to inhibit the germination of four woody species. Although the inhibitory responses observed were inconsistent due to the seeming species-specific resistance, it appeared that extracts prepared from older plants were more effective at inhibiting germination than those from younger plants. Extracts of older plants of birdsfoot trefoil, a legume, were found to contain high concentrations of total phenolics, a group of secondary metabolites, and it was speculated that phenolic concentrations may play key roles in the inhibition of germination. In 1986 these studies will continue with the emphasis being placed on the influence of age of the cover crop from which extracts are obtained on inhibition of germination and total phenolics.

Studies on the effect of soil application of Tordon 101 and Triclopyr on a herbicide-resistant and a herbicide-sensitive tree species were concluded. The roots of the former species, white ash, appeared more tolerant than Carolina poplar to both Tordon

101 and Triclopyr. Differences were apparent in the manner of herbicide uptake by the roots of the two species. The two components of Tordon, Picloram and 2,4-D differed considerably in uptake rate. Picloram uptake seemed to be time-dependent, particularly from 3 to 10 days after application, while 2,4-D uptake over the same period was time-indepedent. Triclopyr seemed to follow the Picloram model. No additional studies are planned in this area for 1986.

Evaluation of the effectiveness of trunk injection of the growth regulators EL-500 and PP 333 into 12-year-old silver maple trees was initiation at the Wesleyville GS herbicide study area. Preliminary measurements of sprout growth during May to October suggest that a slight reduction of growth may already be evident, particularly with EL-500. Since previous studies have suggested that such growth regulators are more effective in the second year after application than the first, sprout growth will be determined after the 1986 growing season.

The data collection portion of the investigation of the movement of Tordon 101 applied to a section of right-of-way on the Des Joachims transmission corridor was concluded. Residues of Picloram and 2,4-D were detected in all the environmental components measured close to the right-of-way, including two of the four lakes sampled, up to ten months following application. Analysis of the data will be completed in 1986.

The study at the McCowan site to determine succession patterns and to identify the source of colonizing species continued. The composition of the understory was assessed. The understory was found to be composed primarily of the four major incompatible species which made up the overstory that had been removed in the fall of 1984 (sugar maple, white ash, trembling aspen, and black cherry). Over 12 000 stems and clumps of stems were identified. The origin of these stems, be they vegetative or from seed, were determined. In 1986 the comparative growth rates of the understory and the vegetative growth on the stumps of the overstory left in 1984 will be assessed.

Evaluation of the effect of time of cutting on the vigour of sprout production at the Wesleyville GS herbicide study area is now in monitoring mode and will continue in 1986.

THERMAL AQUACULTURE

Since 1984 the Section has been investigating the opportunities of using waste heat from our generating facilities for aquaculture schemes. Two projects were initially undertaken: one was to assess the possibility of making thermal aquaculture of rainbow trout a viable alternative to conventional methods, and the second was to develop a new unique aquaculture product for Ontario, the giant freshwater prawn.

The study on rainbow trout concentrated on the feasibility of producing fingerlings at low cost and year round. The premise on which the study was based was that by altering the temperature regimes of the trout eggs one could retard the hatching to a significant degree so that larval production could be controlled. Such a process would eliminate the need of maintaining, manipulating and feeding adult breeders and hence reduce costs. The study has been completed and it was found that eggs held at seven degrees Celsius to the eyed stage and then reducing the incubation temperature to less than four, resulted in good survival and prolongation of hatching. Survival declined with decreases in temperature, it was 90% at four, and barely 70% at one degree. Developmental time could be extended from 60 days at four to over 90 days at one degree. Lowering the incubation temperature to below five degrees at the pre-eyeing stage resulted in catastrophic death of the embryos. There are no plans for further work in this area for 1986.

The studies on freshwater prawns continued in 1985. The thrust was to identify and quantify factors which will make intensive culture of the prawns at these latitudes feasible. The 1985 effort centered on diet and utilization of space.

Growth and survival of the prawns raised on four different diets were evaluated. The diets consisted of chicken starter, chicken starter supplemented with commercial prawn grower, prawn grower, and prawn grower supplemented with fish flesh. Increased growth and mean weights of the animals in the treatment seemed to increase with protein content. The protein content of the fish flesh was not determined and probably was higher than the others, and in fact resulted in the best growth. Survival did not seem to be affected by diet. The study ran for four months, and the average weights ranged 11.6 gm for part fish flesh, 8.7 gm for prawn grower, 6.6 gm for chick starter with grower, and 4.6 gm for chick starter alone. The growth rates are comparable to other nutrition studies but below those in commercial ponds.

A study to determine the feasibility of inducing postlarval individuals to utilize the upper half of the water column on a regular basis was carried out. The results indicated that when cover material was hung from the surface of tanks approximately half of the animals would redistribute themselves to the upper half of the tanks. The results were consistent for all ages tested, time of day, and temperature. The active preference for cover material is consistent with the recommendations of others who showed that postlarvae grown with heavy cover tended to yield better survival rates.

Observations by our researchers suggested that the animals tended to survive better and prefer organically-enriched waters. This premise was tested in a series of tanks where water flow was regulated to control the "cleanliness" while all other variables

remained constant. Under no flow and at the maximum flow (14 water changes per day) there were virtually no survivors after 16 weeks. At one and seven changes per day reasonable survival was evident.

New studies that have been initiated include studies of growth and survival in cages with both vertical and horizontal mesh surfaces, and growth and survival under varying feeding intensities.

A problem with all of the above studies has been the large variation in the sizes of the animals at harvest. Since we had no control over the breeding stock, it has been impossible to find or solve the cause of the size variations. Generally workers in the field have implicated agonistic behaviour, the release of inhibitory substances, and sex related variances. Through 1986 much of the effort will be on the completion of the ongoing studies, and the initiation of work to develop a large product with more size homogeneity.

OVERVIEW

This report has sought to present an overview of the range of activities undertaken by the Biological Research Section through 1985, and to provide an indication of the projected work for 1986.

1985 was an exciting year for the Section with encouraging results being obtained in most of the areas where new studies were being undertaken. The productivity and quality of the Section's work were at an all time high. In a number of areas the proposed studies were not done or were significantly behind target. Areas hardest hit were the ecological aspects of vegetation control, biofouling and the development of remote sensing capability. The significant loss of staff through the year seriously impacted the work, particularly the vegetation control program.

The Section's work is supported from three sources of funds: external clients, corporate clients and divisional funds, and has been in the following divisional program areas:

General	Transmission
Utilization and Conservation	Environment
Nuclear	

The overall breakdown of the funding in the five categories as a percentage of total is shown in the following table; 1986 estimates are shown in parenthesis.

TABLE 1

	External	Corporate	Divisional	
General	0	0	5	5
( )	0	0	(7)	(7)
Utilization and Conservation	0	0	8	8
( )	0	0	(6)	(6)
Nuclear	0	1	5	6
( )	0	(2)	(11)	(13)
Transmission	0	1	7	8
( )	0	0	(8)	(8)
Environment	11	47	15	73
( )	(11)	(48)	(7)	(66)
	11	49	40	
	(11)	(50)	(39)	

Historically the Section has carried out and relied on work in environmental areas, as is the present case. Most of the funding from corporate and external sources has been and is limited to aquatic environmental studies.

Attempts have been made over the last few years to emphasize the ability of this Section to support the corporation in a number of areas, other than environmental, where biology can play a role in solving problems and creating opportunities. This has been achieved by redistributing more equitably the Divisional funds among the five work programs to develop capabilities in Conservation and Utilization, Nuclear and Transmission at the expenses of Environmental. As shown below, the trend is expected to continue in 1986.

TABLE 2

DISTRIBUTION OF DIVISIONAL FUNDS AMONG THE FIVE PROGRAM AREAS (PER CENT OF TOTAL)

	1985	Projected 1986
General	13	17
Utilization and Conservation	21	17
Nuclear	13	25
Transmission	16	21
Environmental	37	20

Approved by:

O.A. Kupcis
Manager
Chemical Research Department

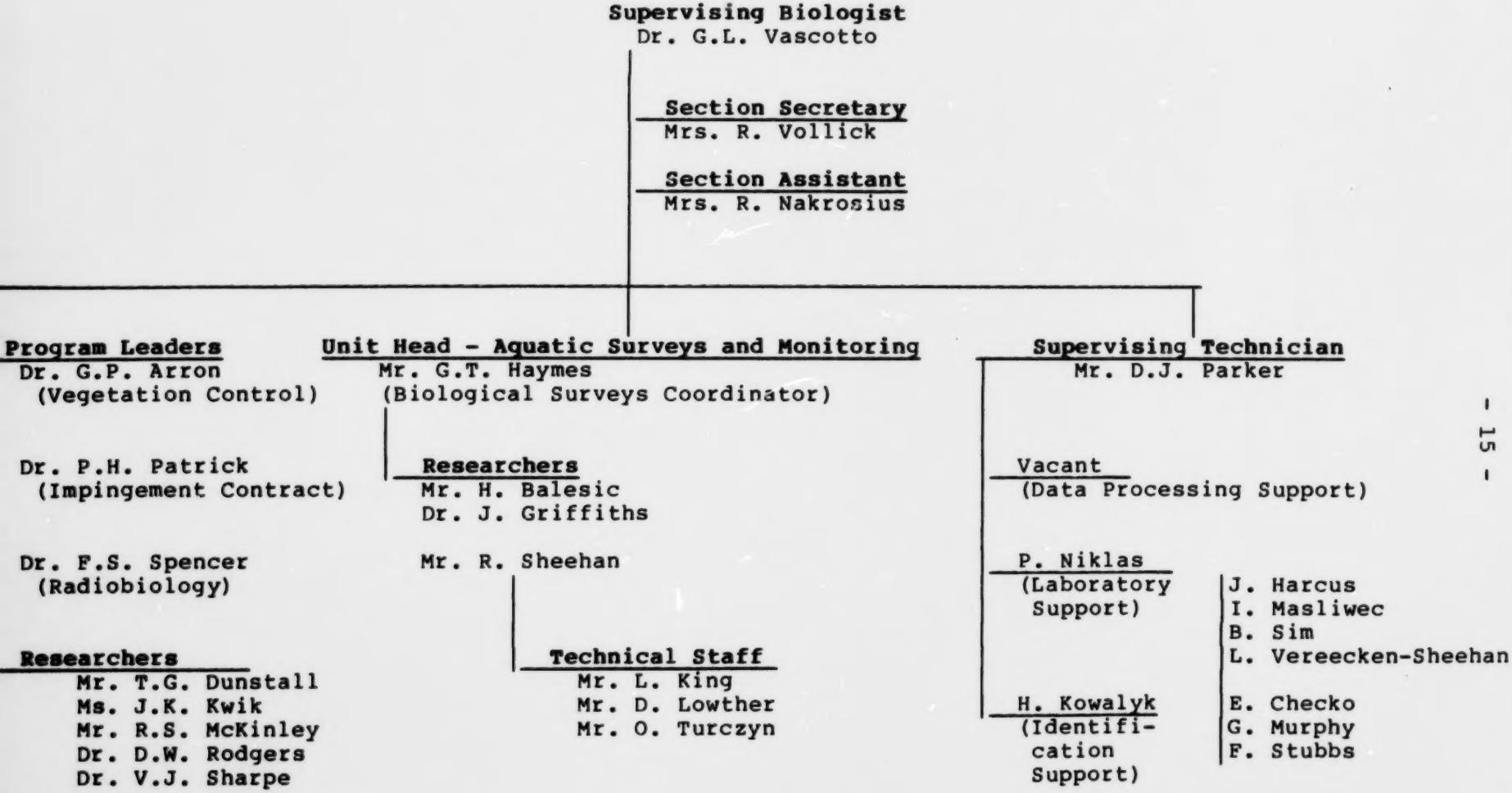
Prepared by:

G.L. Vascotto
Supervising Biologist
Biological Research Section

GLV:rv

APPENDIX A

Biological Research Section Organization Chart



APPENDIX B

1985 Staff List

Supervising Biologist
Dr. G.L. Vascotto

Section Secretary
Mrs. R. Vollick

Section Assistant
Mrs. R. Nakrosius

Unit Head - Environmental Surveys and Monitoring

Mr. G.T. Haymes (Biological Surveys Coordinator)	biological surveys, bird biology, field impingement tests

Researchers

Dr. G.P. Arron (Vegetation Control Coordinator)	vegetation control, plant biochemistry
Mr. H. Balesic	biological surveys, acoustic fish census
Mr. T.G. Dunstall	tritium in soils, biological catalysis, deuterated lubricants
Dr. J.S. Griffiths	intake technologies, fish impingement, fish physiology, biological surveys
Ms. J.K. Kwik	prawn aquaculture, zooplankton
Mr. R.S. McKinley	radionuclides in sediments, biofouling, movements of herbicides, larval entrainment
Dr. P.H. Patrick (Impingement Contract Coordinator)	fish impingement, bioenergetics
Dr. D.W. Rodgers	radionuclides in fish and sediments, fish removal techniques, fish physiology
Dr. V.J. Sharpe	biofouling
Mr. R.W. Sheehan	biological surveys, field surveys

APPENDIX B (concluded)

1985 Staff List

Researchers (continued)	
Dr. F.S. Spencer (Radiobiology Coordinator)	tritium dynamics, vegetation control, plant biochemistry

Supervising Technician
Mr. D.J. Parker

Lead Technicians
Mr. H. Kowalyk
Mr. P. Niklas

Technical Staff
Mr. E. Checko
Mr. J. Harcus
Mr. L. King
Mr. D. Lowther
Ms. I. Masliwec
Mr. G. Murphy
Mr. B. Sim
Mr. F. Stubbs
Mr. O. Turczyn
Ms. L. Vereecken-Sheehan

APPENDIX C

Reports Issued in 1985

85-3-K	The Distribution and Abundance of Gamma Emitting Radionuclides in Lake Ontario Sediments	R.S. McKinley	Research
85-40-K	Thermal Discharge Displacement of Simulated Littoral Drift Fish Larvae	W.E. Carey	Design & Develop
85-46-K	Potential Applications of Biological Catalysis in Fusion and Fission Technologies	T.G. Dunstall	Research
85-52-K	Biofouling - Biomass Measurement	V.J. Sharpe	CNS
85-59-K	Assessment of Ichthyoplankton Entrainment at Pickering 'A' NGS Using a Pump/Net in Lake System	R.S. McKinley	Research
85-81-K	Atikokan GS Preoperational Aquatic Survey Year III, 1983-1984	G.T. Haymes	Design & Develop
85-82-K	Responses of Profundal Benthos to Lakes of Varying Acidities	G.L. Vascotto	Research
85-173-K	Biological Research Section - 1984 Annual Report	G.L. Vascotto	Research
85-183-K	Tritium Uptake Kinetics in Crayfish (Orconectes immunis)	P.H. Patrick	Design & Develop
85-192-K	Comparative Growth of Macrobrachium rosenbergii Raised on Four Different Diets	J.K. Kwik	Research
85-258-K	Evaluation of Fish Handling System - Bruce NGS 'A'	J.S. Griffiths	Design & Develop
85-264-K	Absorption, Translocation and Effect on Survival of 2,4-D, Picloram and Triclopyr in White Ash and Carolina Poplar After Soil Application	G.P. Arron	Research

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APPENDIX C (continued)

Reports Issued in 1985

85-271-K	Microbial Effects - Radioactive Waste Disposal - Summary Report	V.J. Sharpe	Design & Develop
85-312-K	Effectiveness of a Hidrostal Pump in the Live Transfer of American Eels - Field Study 1985	P.H. Patrick and R.S. McKinley	Design & Develop
85-319-K	Biosynthesis of Deuterated Organic Compounds for Lubricant Applications	T.G. Dunstall	Research
85-333-K	Atikokan GS Interim Aquatic Survey - January 1984 to June 1985	G.T. Haymes	CTS
85-337-K	The Influence of Varied Temperature Regimes on the Development of Rainbow Trout Embryos	R.S. McKinley	Research
C85-2-K	Static Bioassay of Darlington 'FHA' Wash	D.W. Rodgers	Design & Develop
C85-8-H	The Effects and Social Cost of Fossil-Fired Emissions on the Aquatic Ecosystem Due to Electrical Exports	G.T. Haymes	CTS
C85-12-K	Progress Report on Handling Procedures and Experimental Facilities for the Freshwater Prawn	J.K. Kwik	Research
C85-21-K	Toxicity Testing of Darlington 'FHA' Wash	V.J. Sharpe	Design & Develop
C85-38-K	Characterization of Tritium-Oxidizing Micro-organisms	V.J. Sharpe	Research
C85-69-K	Report on an International Conference on Biologically-Induced Corrosion, Gaithersburg, Maryland	V.J. Sharpe	Research
C85-103-K	Prawn Growout Study	J.K. Kwik	Research

APPENDIX C (concluded)

Reports Issued in 1985

C85-104-K	Examination of Storage Water in Boilers at Pickering NGS for Microbial Contamination	V.J. Sharpe	Research
C85-109-K	Biological Assessment of an Increased Summer Effluent Temperature at Lambton GS	G.T. Haymes	CTS
C85-115-K	Progress Report: McCowan Road Right-of-Way Study, Post-Clearing Conditions	G.P. Arron	Research
CB85-1-K	Herbicide Content of Water Samples Collected in 1984 Near the Herbicide Study Area, Wesleyville GS	G.P. Arron	Research
CB85-2-K	Herbicide Content of Water Samples Collected in 1985 Near the Herbicide, Study Area, Wesleyville GS	G.P. Arron	Research

APPENDIX D

List of Publications by Biological Research Section Staff in 1985

Author	Title	Journal	Publication Info
G.P. Arron	Effect of Trunk Injection of Tree Growth Regulators on Sprout Growth in Silver Maple	J. of Arboriculture	11(10)301-306
T.G. Dunstall	Effects of Entrainment of Phyto-plankton Primary Production at Four Thermal Electric Generating Stations on the Laurentian Great Lakes	Internationale Revue der gesamten Hydrobiologie	70(2):247-257
T.G. Dunstall G.T. Haymes J.K. Kwik	Influence of a Thermal Electric Generating Station on Water Chemistry and Distribution of Plankton	Journal of Great Lakes Research	11(4):530-539
T.G. Dunstall G.L. Ogram F.S. Spencer	Elemental Tritium Deposition and Conversion in the Terrestrial Environment	Fusion Technology	8(2):2551-2556
G.T. Haymes P.H. Patrick L. Onisto	Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay	Internationale Revue der gesamten Hydrobiologie	69(6):867-876
J.K. Kwik T.G. Dunstall	Mortality of Zooplankton Resulting from Temperature Regimes Encountered in Once-Through Cooling Systems	Journal of Great Lakes Research	11(1):26-33
P.H. Patrick A.E. Christie D. Sager C. Hocutt J. Stauffer, Jr.	Response of Fish to a Strobe Light/ Air Bubble Barrier	Fisheries Research	3:157-172
P.H. Patrick B. Sim	Effectiveness of a Hidrostal Pump in the Live Transfer of American Eels	Hydrobiologia	128:57-60
D.W. Rodgers P.H. Patrick	Evaluation of a Hidrostal Pump Fish Return System	North American Journal of Fisheries Management	5:393-399

APPENDIX E

List of Conference Papers Presented by Biological Research Section Staff in 1985

Author	Title	Conference	Date/Place
T.G. Dunstall G.L. Ogram and F.S. Spencer	Deposition and Conversion of Elemental Tritium in the Terrestrial Environment	American Nuclear Society National Topical Meeting on "Tritium Technology in Fission, Fusion and Isotopic Applications"	Apr 30-May 2/85 Dayton, Ohio
G.L. Vascotto	Responses of Profundal Benthos to Lakes of Varying Acidities	Canadian Congress of Biology	June 24-29/85 London, Ontario
G.T. Haymes P.H. Patrick	Effectiveness of Pneumatic Poppers in Excluding Fish from Water Intakes	Edison Electric Institute Biologists' Workshop	Oct 6-9/85 Claremont, CA

APPENDIX F

List of Contracts Awarded to Biological Research Section in 1985

Department	Funded by	Title	Amount
Chemical (G.T. Haymes)	Nanticoke Environmental Committee	Nanticoke Environmental Committee Effects Report	60,000
Chemical (P.H. Patrick)	ESEERCO	Alternative Fish Protective Techniques; Development of the Fish Drone	104,000
Chemical (P.H. Patrick)	EPRI	Evaluation of Behavioural Systems	400,000
Chemical (P.H. Patrick)	CEA	Behavioural Systems at Hydraulic Sites	123,000